REVOLUTIONIZE AVIATION

Future Air Traffic Management Concepts Evaluation Tool (FACET)

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The air transportation system is on the verge of gridlock, with delays and cancelled flights reaching all time highs. To understand the causes of these problems and to identify the potential benefit of new technologies or procedures, Ames has taken the first step in developing a system-level modeling and simulation capability referred to as Future ATM (Air Traffic Management) Concepts Evaluation Tool (FACET). FACET provides a flexible simulation environment for exploring, developing, and evaluating advanced ATM concepts.

FACET simulates system-wide air traffic operations over the contiguous United States, utilizing models of aircraft performance, weather, and airspace features to synthesize aircraft trajectories. Figure 1 shows the various input sources, main components, and some of the applications of FACET. FACET's modular software architecture strikes an appropriate balance between flexibility and fidelity. This innovative feature enables FACET to model airspace operations at the national level and to process over 5,000 aircraft on a single desktop computer for a variety of operating systems. The software architecture of FACET successfully blends two programming languages, "Java" for the graphical user interfaces and "C" for the underlying computational engine, with state-of-the-art software development practices. These two features are essential ingredients to the portability and versatility of FACET.

As shown in figure 1, four advanced air traffic management (ATM) concepts have been successfully evaluated with FACET. A fifth application, system-wide optimization, is under development. A flight-deck-based conflict-detection and resolution-feasibility study showed that free maneuvering operations (a key element of free flight) are not adversely affected by the decentralization of control authority associated with self-separation. The direct-to routing analysis indicated that national deployment of a newly developed Ames controller decision support tool, Direct-To, could result in cost savings of $200 million per year. The Playbook Evaluation Tool is a first step in developing advanced traffic-flow management techniques for aircraft rerouting and airspace redesign. FACET has also been used to study the integration of aircraft and space launch vehicle operations in the U.S. National Airspace System. Those in the Advanced Space Transportation Program expect the number of reusable and other space launch vehicles to increase significantly over the next decade. The FAA Office of Commercial Space Transportation has requested FACET to evaluate the FAA's future Space and Air Traffic Management System (SATMS).

Figure 2 is an example of a FACET display mode. The display shows current aircraft locations, Center boundaries, and changes to aircraft routes. This together with numerous other graphic interface capabilities allows the researcher to quickly assess the results of a specific analysis or study.

The capabilities of FACET have been demonstrated to a large and diverse group of ATM experts from industry, academia, and the government; the feedback received to date has been overwhelmingly positive. A patent application for FACET is being prepared. Several organizations have requested and received a copy of the FACET software for collaborative work under a NASA Non-Disclosure Agreement.

FACET has become a powerful ATM simulation tool with the capability to evolve into a decision support tool for Traffic Flow Management. The FACET development approach—to build and expand functionality as needed while meeting the requirements and schedule of a focused program—has produced a versatile ATM tool at a very low cost.

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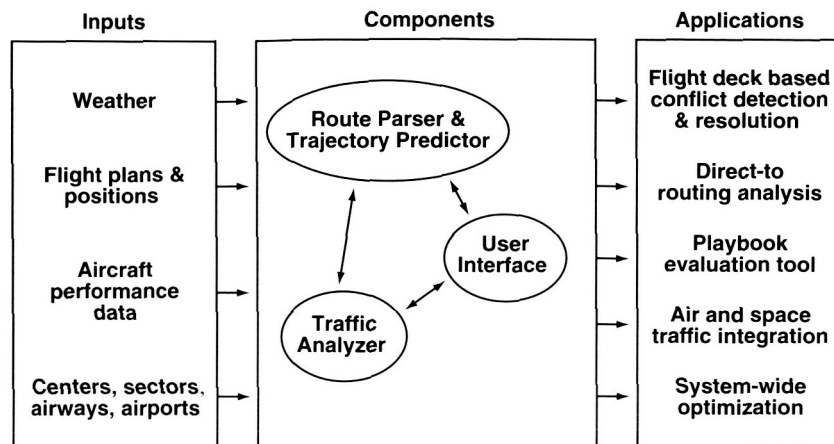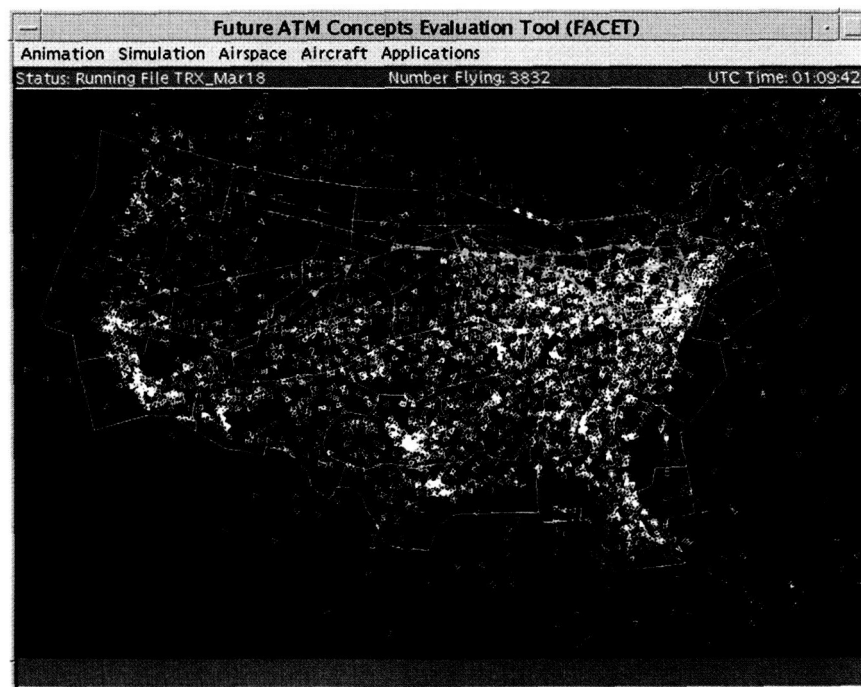| Inputs	Components	Applications
Weather	Route Parser & Trajectory Predictor	Flight deck based conflict detection & resolution
Flight plans & positions		Direct-to routing analysis
Aircraft performance data	User Interface	Playbook evaluation tool
	Traffic Analyzer	Air and space traffic integration
Centers, sectors, airways, airports		System-wide optimization

Fig. 1. FACET architecture.

Fig. 2. Modeling of TFM concepts using FACET.